CLAIMS

What is claimed is:

1. An attenuating phase shift mask blank for use in lithography comprising:

substrate;

an etch stop layer deposited on said substrate;

a phase shifting layer disposed on said etch stop layer; and

said phase shift mask blank being capable of producing a photomask with substantially 180° phase shift and an optical transmission of at least 0.001% at a selected wavelength of <500nm.

2. An attenuated phase shift mask blank according to claim 1, wherein the phase shifting layer comprises a composite material of formula $A_wB_xN_yO_z$, where A is an element selected from the group consisting of Groups IVA, VA, or VIA; and B is selected from the group consisting of an element from Groups II, IV, V, the transition metals, the lanthanides and the actinides; wherein w is from about 0.1 to about 0.6, x is from about 0 to about 0.2, y is from about 0 to about 0.6, and z is from about 0 to about 0.7.

3. An attenuated phase shift mask blank according to claim 1, wherein the phase shifting layer comprises a silicon/titanium/nitrogen/oxygen composite.

4. An attenuating phase shift mask blank according to claim 3, wherein said silicon/titanium/nitrogen/oxygen composite has structural formula $Si_wTi_xN_yO_z$ wherein w is about 0.1 to about 0.6, x is from about 0 to about 0.2, y is from about 0 to about 0.6, and z as from about 0 to about 0.7.

5. An attenuating phase shift mask blank according to claim 1, wherein the phase shifting layer has a thickness of from about 400 Å to about 2000 Å.

6. An attenuated phase shift mask blank according to claim 1, wherein the etch stop layer comprises a material selected from the group consisting of a metal or a composite material where the composite material comprises a material selected from the group consisting of a metal, an element from Groups II, IV, and V, Nitrogen and Oxygen.

7. An attenuated phase shift mask blank according to claim 6, wherein the etch stop layer comprises a material selected from the group consisting of titanium and tantalum.

8. An attenuating phase shift mask blank according to claim 6, wherein the etch stop layer has a thickness of from about 50 A to about 500 A.

9. An attenuating phase shift mask blank according to claim 1, wherein the phase shifting layer is SiTiO and the etch stop layer is Ta.

10. An attenuating phase shift mask blank according to claim 1, wherein the phase shifting layer is SiTiO and the etch stop layer is Ti.

11. A method of fabricating an attenuating phase shift mask blank for use in lithography comprising:

providing a substrate;

disposing a thin layer of etch stop layer on said substrate;

disposing a layer of phase shifter layer on said substrate;

said blank is capable of producing a photomask with 180° phase shift and an optical transmission of at least 0.001 % at a selected wavelenth of <500nm.

12. A method according to claim 11, wherein the phase shifting layer comprises a composite material of formula $A_wB_xN_yO_z$, where A is an element selected from the group consisting of Groups IVA, VA, or VIA; and B is selected from the group consisting of an element from Groups II, IV, V, the transition metals, the lanthanides and the actinides; wherein w is from about 0.1 to about 0.6, x is from about 0 to about 0.2, y is from about 0 to about 0.6, and z is from about 0 to about 0.7 .

13. A method according to claim 11, wherein the phase shifting layer comprises a material selected from the group consisting of a silicon/titanium/nitrogen composite and a silicon/titanium/nitrogen/oxygen composite.

14. A method according to claim 11, wherein said silicon/titanium/nitrogen/oxygen composite has structural formula $Si_wTi_xN_yO_z$ wherein w is from about 0.1 to about 0.6, x from about 0 to about 0.2, y is from about 0 to about 0.6, and z is from about 0 to about 0.7.

15. A method according to claim 11, wherein the phase shifting film is formed by sputter deposition from two or more targets of different compositions using a technique selected from the group consisting of RF matching network, DC magnetron, AC magnetron, pulsed bipolar DC magnetron, Ion beam assisted deposition, Ion beam sputter deposition and RF diode.

16. A method according to claim 15, wherein the phase shifting layer is formed by sputter deposition from a target of a composite material ($Si_{1-x}Ti_x$) wherein x is from about 0 to about 0.5 by a method selected from the group consisting of RF matching network,

DC magnetron, AC magnetron, pulsed bipolar DC magnetron, Ion beam assisted deposition, Ion beam sputter deposition and RF diode.

17. A method according to claim 15, wherein the substrate is disposed in a holder which can be either planetary or stationary and/or rotating or non-rotating.

18. A method according to claim 11, wherein the phase shifting film is formed by sputter deposition from two or more targets of different compositions using a technique selected from the group consisting of RF matching network, DC magnetron, AC magnetron, pulsed bipolar DC magnetron, Ion beam assisted deposition, Ion beam sputter deposition and RF diode.

19. A method according to claim 18, wherein said two or more targets are selected from the group consisting of SiO_2 targets and Ti targets, or $(Si_{1-x}Ti_x)$ targets wherein x is from about 0 to about 0.5 and Ti targets.

20. A method according to claim 18, wherein the substrate is disposed in a holder which can be either planetary or stationary and/or rotating or non-rotating.

21. A method according to claim 1, wherein the substrate is annealed at elevated temperature in an atmosphere selected from the group consisting of air, oxygen, vacuuma and a mixture of gases selected from the group consisting of O_2, N_2, H_2, Ar, Kr, Ne, He, O_3 and H_2O.